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ABSTRACT

Recent developments in software and hardware capabilities have made possible the combination of the Music Achievement Test (MAT) series and the PLATO music programs as a new delivery system. Initial reactions to the PLATO administration of digital to analog (D to A) testing in music have been positive; the immediate feedback available by computer, plus the individual pacing of the student are good reasons for this early success. The mode of test presentation remains a major question for extensive further study. If computer administered testing is standardized in the future, the chore of item analysis and test validation can be an easy matter, and it will be possible to have a continuous updating of norms. (VT)

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COMPUTER-ASSISTED INSTRUCTION APPLICATIONS TO STANDARDIZED MUSIC ACHIEVEMENT TESTING

by

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COMPUTER-ASSISTED INSTRUCTION
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Introduction:

The combination of two major areas in evaluation and instruction is currently the subject of research at the University of Illinois: these areas are 1) standardized testing, and 2) computer-assisted instruction. The Music Achievement Test series was developed from 1967 to 1970, resulting in a four level series of tests with national norms (Colwell, 1967, 1970). As the fourth level of MAT was being completed, research was initiated in the use of the PLATO computer for music instruction.

The recent (1977) development of software and hardware capabilities has made the present research project possible: that is, the combination of the MAT series and the PLATO music programs as a new delivery system. This exciting combination has potential, not only for music achievement testing, but for all types of standardized testing. The research has raised some interesting questions which have significant implications for the entire field of computer-assisted instruction.

Standardized Music Testing:

Standardized testing is an idea which has grown with force and power equal to any of the educational movements of the Twentieth Century. In the development and use of standardized aptitude and achievement tests, music has not been slighted. Seashore reported his first efforts at measuring musical aptitude as early as 1912; these efforts culminated in the

publishing of the first standardized music test (Seashore, 1919). Seashore's test measured only aural skills, for he was convinced that aural ability was the result of aptitude, while other musical skills were more largely the result of training. The Seashore test was viewed as a potential godsend by the music and academic communities because the training of a musician is expensive, long, and arduous.

Judgment of musical performance remains today the most widely used criterion for admittance to formal musical instruction, and even, in many cases, for obtaining a teaching or performing position in music. However, other factors are increasingly seen as part of the common denominator of the musician, whether teacher, musicologist, composer, or critic. Aural skills, including those Seashore proposed, are now considered basic, both for instruction and as evidence of achievement. We now view many of these aural skills amenable to training, and not necessarily dependent upon aptitude as Seashore believed. Aural skills are often difficult to measure, but computer-assisted testing has made the development of standardized tests in music more feasible than at any previous time.

Audio Capabilities in CAI:

Since 1967, sound capabilities for the programing of CAI music materials have been improved. The technology for random-access recording and tape systems has existed for years, but only recently has it been developed to a state considered acceptable to the musician.

The PLATO Music Project at the University of Illinois began in 1970 with the investigation of the audio capabilities of the PLATO III computer-assisted instructional system. Two CAI projects in music were begun during the latter part of the 1969-1970 academic year: Placek (1972) designed lessons to implement a random-access audio device in an elementary music fundamentals program; at the same time, an interface was developed for the judgment of pitch and rhythm performance (Peters, 1974). The current research into computer-assisted testing is a logical projection of this early audio research.

The development of the digital to analog (D to A) interface for computers has been enhanced by the microprocessor. Acceptable one and four-voice sound generators sufficient for programing "perception" drills in music are being used successfully

on several campuses. Continued developmental work will yield, within the present calendar year, a multi-voice tone generator with machine-controlled timbre and enveloping capabilities.

Similar advancements in technology have revolutionized the possibilities for the development of the A to D interface for programing music performance juding. Early studies by Allvin (1967) and Peters (1974) predate the many currently available integrated circuits and processing units. Although this capability is not currently needed for the Music Achievement Tests, the added capability of evaluating performance in a systematic manner is very attractive when considering the computer consistency in pitch and rhythm judgments.

Computer-Assisted Test Administration in Music:

When first conceived, the idea of standardized tests administered with the aid of the computer yielded the obvious advantages of rapid scoring, immediate accessibility to norms, and the ability to call instantly needed data in interpreting scores rather than wading through the cumbersome manuals mandated to meet the cautions of the AERA and APA in the Standards for Educational and Psychological Tests. The additional concerns created by social consequences of music testing seemed resolvable through this application of the computer.

Easy access to data collection and evaluation makes the application of standardized testing and CAI a natural result. Although use of a standardized test is still appropriate when one has to make only one or a limited number of choices, the basic format of testing has become less acceptable. Paper and pencil tests are cumbersome. Hand scoring of tests is not only time consuming but potentially inaccurate. Of greater significance is the disruptive nature of administering a standardized test in areas where test-taking is infrequent. The freedom of the classroom occasioned by individualized instruction, CAI, nongraded schools, and independent learning is not compatible with testing when everyone must stop what he is doing to take the test. Music tests require a phonograph or tape recorder, almost total silence to minimize interference from others, a need for everyone to progress at the same pace; all activities foreign to contemporary learning theory. In other words, a student is tested in a context unlike that in which he learned, raising a major concern for content validity.

Many unexplored advantages of the computer administration of music tests soon become apparent. With both aural and visual capabilities developed in CAI, the student has better reinforcement than is possible with the usual configuration of the teacher giving some directions. accompanied by limited directions on the machine-scored answer sheet, and additional directions and examples on the tape or recording. Coordination of visual and aural directions is possible so that the role of the teacher can be eliminated.

A second advantage is that the student can ask that the aural directions be repeated, thus insuring that he understands the task, the procedure, the method of responding, and any score procedures that might affect the way he approaches the task. A way has been found to (1) avoid the critical problem of "mind wandering" during the giving of directions and (2) attenuate the negative effects of speeded tests, a characteristic of all music tests using aural stimuli. These minor modifications, possible with PLATO, in all likelihood, improve the validity of any test.

PLATO provides the choice of computer-generated sound or generation of stimuli from high-fidelity tape. Music aptitude tests have long been criticized because computer-generated sound was amusical, yet computer-generated sound remains the most viable method to test pitch differentiations of less than a half step, an important distinction in music. Further, computer-generated sound can be controlled for overtones, timbre, dynamics, attack and steady state of the tone and other variables which may interfere with a subject's ability to distinguish pitch. (Recall that in music pitch is the consideration, not frequency.) Tape-generated stimuli, while possibly musical, possessed not only a lack of control but were inconsistent in quality, and were influenced by prior learning and familiarity and thus subject to cultural biases. Computer-assisted testing will make possible the investigation of the effect of the type of stimuli and thus obtain some valid measures of pitch discrimination.

A troublesome question for both testing and learning is the positive and negative effects of immediate feedback. If the student views CAI as a test, is there a relationship between programing and testing via the computer? With a standardized test, should the student receive immediate feedback as to the correctness of his answer? What is the role of a neutral response that merely encourages the student to proceed to the

next question? If the student can determine his score immediately after completing the test and before the teacher knows the score, how does this affect the student's class performance and relationship to the teacher? If the teacher is not able to comment on the meaning of a computer assigned grade and has a reason to sit down with the student and go over his work, how does this affect the testing situation?

The answer to these questions are important if we are to use the computer for testing as well as teaching. The answers are also critical to interpreting the results of standardized tests given via computer. Validity, which is the most crucial element in education as well as in testing, has been found to be enhanced by the use of the computer. The computer enables us to move closer to measuring, because we are able to remove much of the error of the testing situation as well as some of the errors in the test instrument. Interestingly, we do not know, in administering standardized tests with PLATO, whether we have invalidated the norms. In achieving greater standardization and a more valid instrument, have we raised or lowered test scores? This question is as yet unanswered.

MAT Computer Program Development:

The operation of the MAT computer program utilized the PLATO terminal equipped with the "Gooch Music Box", a digital-to-analog device for production of music. The program written for MAT stored the raw score for each student by test-section. The student raw score was then compared to the standardized percentile scores before being stored in permanent records. Raw scores, as well as computer percentile scores, were retained during the study.

Added program capability allowed the teacher/researcher to review student scores by group or class level. This graphic display aided in comparing control-group with the experimental group; or for the teacher in comparing the class with national, school district or regional norms as they develop. By increasing the data-base, scores for students could be retained for a longitudinal study by a single teacher or an entire school district.

Data was collected as MAT was administered in all of the following modes of presentation:

1. by PLATO with the "Gooch Music Box".

2. by PLATO with random-access tape playback, controlled by computer.
3. by the classroom teacher as per normal manual instructions. (This method required the use of a long-playing phonograph record and machine-readable score sheets.)

Program development involved the recording of new test instructions for students taking the random-access audio version of the test. All actual music examples and test items were transferred directly from the phonograph recording to the random-access audio recording for testing purposes.

Programming of the "music box" version of MAT 1 required the encoding of all music materials into computer code. In this manner, all music examples and test items were programed directly into the computer test (lesson). Care was taken to reproduce the computer-generated music items at the same pitch and tempo as those recorded for the original test.

Replacing the standardized optical-scan test form were written instructions appearing on the PLATO terminal screen. In the random-access audio version of MAT 1, student instructions were given in recorded verbal form, as they also appeared on the computer screen. This is similar to the procedures of the traditional method of administering the test, i.e., recorded instructions and test form examples. In the music-box version of the test, no verbal instructions were given to the student. In this method, the student was required to read the instructions, try questions, and proceed, with no other instructions. Although it was possible to incorporate verbal instructions from the random-access audio with the music box method, it was not part of the experimental design.

In reviewing the data, evaluation was made of the three different means of administering the test to students randomly selected from grade schools in Champaign, Illinois.

Results from pilot testing of the MAT programs have yielded positive results, in that students had no difficulty with the computer-administered forms of the test. Data is still being collected to determine the difference and significance of the electronically produced "Gooch Music Box" sound as compared to the recorded instrumental music examples. Although this difference may be of little concern in the non-music test areas, the question of transfer and pitch perception must be

resolved in this case.

All data-collection programing routines functioned as anticipated. Student records for each participant stored information of part-scores, raw score, percentile by region, grade, and national norms. Added information was reviewed on the time students needed to complete the test on the PLATO system.

Conclusions:

Initial reaction to the PLATO administration of D-to-A testing in music has been positive. The immediate feedback available by computer, plus the individual pacing of the student are good causes for this early success. The mode of test presentation remains a major question for extensive further study. Whether to allow the student 1) repeated hearings of items, 2) reinforcement by item or section, and 3) an open time-frame, are all debatable points when comparing results to the early norming of standardized tests.

If computer administered testing is standardized in the future, the chore of item analysis and test validation can be an easy matter. It is possible to have a continuous updating of norms.

The evaluation community is presently divided over normative versus criterion referenced tests. The primary difference between the two types of instruments is in how they are used and in some areas, how they are constructed. Data on call are acceptable where printed data are not. We now have the potential that, by altering the program, the same test or a test with only a few items changed can serve as either a criterion-referenced test or a norm-referenced test.

In schools utilizing CAI, considerable benefit would accrue from the use of the computer for periodic evaluation. Teachers and researchers are primarily interested in gains by question, task, or some small component of a test than in the total score. The use of graphics on raw scores or profiles of students allows for diagnostic work never before possible. The advantages of using CAI systems for systematic evaluation appear to be as great as the uses of CAI for instruction.

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